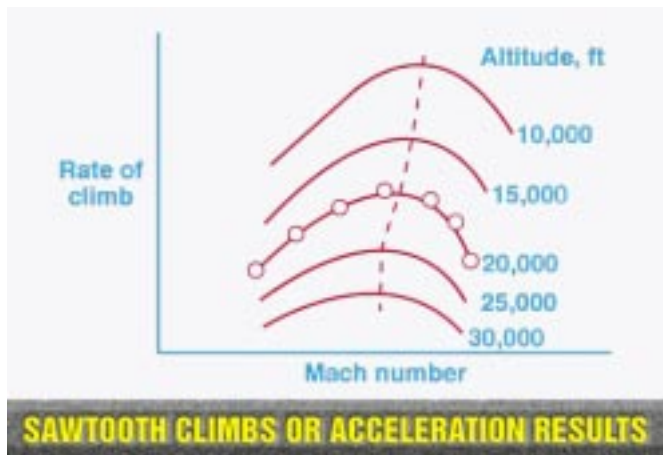


# Information Summaries

IS-97/08-DFRC-C1

## Check Climb Background



The ACCEL-DECEL and SAWTOOTH CLIMB test maneuvers are used to define the best-rate-of-climb and speed-for-best-rate-of-climb for one altitude. After these maneuvers have been repeated at several altitudes, the resulting data are plotted together as shown.

If the pilot were to fly a climb such that the airplane was at the best-climb speed as it passed through each altitude, it would be achieving the best possible rate of climb for the entire climb. This is known as the "best-climb schedule" and is identified by the dotted line.

The best-climb speeds can be cross plotted vs altitude as shown in figure below which is a more useful form for presenting the climb schedule.

Flying the best-climb schedule will allow the airplane to reach any desired altitude in the minimum amount of time. This is a very important parameter for an interceptor attempting to engage an incoming enemy aircraft. For an aircraft that is equipped with an afterburner, two best climb schedules are determined; one for a Maximum Power climb (afterburner operating) and one for a Military Power climb (engine at maximum RPM but afterburner not operating). The Max Power climb will result in the shortest time but will use a lot of fuel and thus will be more useful if the enemy aircraft is quite close. The Mil. Power climb will take longer but will allow the interceptor to cruise some distance away from home base to make the intercept.



For cargo or passenger aircraft the power setting for best climb is usually the maximum continuous power allowed for the engines. By flying the best-climb schedule the airplane will reach it's cruise altitude in the most

efficient manner, that is, with the largest quantity of fuel remaining for cruise.

By applying a calculus process called integration to the rate of climb data obtained from the SAWTOOTH CLIMBS and ACCEL DECELS, it is possible to predict the time-to-climb and fuel used if the airplane were to be flown on the best-climb schedule.

The check climb is a test maneuver which "checks" these predicted climb characteristics by attempting to fly the best-climb schedule and recording the actual time and fuel used.

### **1. Specific Objective of the Test**

The primary purpose of the check climb is to validate the predicted time-to-climb and fuel-used data obtained from other test sources. A secondary objective is to assess the practicality of the "best-climb schedule", that is, can the adjustment in speed as altitude increases be accomplished by a proficient pilot. Part of this secondary objective is to establish the best piloting technique for transitioning from the takeoff and initial level acceleration to the desired climb on the climb schedule.

### **2. Critical Flight Conditions**

A check climb covers a wide range of speeds and altitudes. The most critical aspect of the test is the condition of the atmosphere at the time of the test. Winds aloft, wind shears, or unusually hot or cold temperatures will strongly influence the ability of the pilot to maintain the climb schedule. These non-standard atmospheric conditions could also result in the application of large, and possibly erroneous, corrections to the resulting data in order to establish a standard-day check climb. The weight of the airplane at the beginning of the test is also crucial to the outcome.

### **3. Required Instrumentation**

The parameters usually measured and recorded during a check climb are shown in Table (1-1). The engine instruments shown are representative but not complete. The engine instrumentation will be used to correct the thrust and fuel flow data to standard day pressures and temperatures.

A continuous time history of these parameters is needed throughout the actual maneuver which usually begins at brake release. A sampling rate of at least 10 data samples every second is necessary to accurately record the maneuver, and each data sample must be accurately time correlated with the data samples of the other parameters. That is, we must be able to relate a particular measurement of fuel flow and time-from-brake-release with a measurement of Mach number and altitude.

### **4. Starting Trim Point**

The starting point for a check climb is usually brake release at the start of the takeoff roll. Although the airplane is not really checking the best-climb schedule until after the pilot has completed the takeoff, acceleration and transition, the check climb maneuver usually includes the total time and fuel used from brake release.

### **5. Description of a Check Climb**

In order to accurately establish the weight at the start of the maneuver, a special fueling and weight measurement may precede the engine start, and the airplane might be positioned closer to the runway to avoid a long taxi time. The test begins on the runway by establishing Military Power with the brakes on. Time starts when the brakes are released. If the check climb is to be in afterburner, the afterburner is ignited simultaneously with brake release. The pilot completes a normal takeoff with rapid gear and flap retraction. The airplane is allowed to accelerate at low altitude to a speed somewhat below the speed for best climb. The pilot then performs a fairly abrupt pullup and attempts to stabilize on the best climb speed schedule at the lowest practical altitude. (For a fighter in full afterburner, this transition maneuver

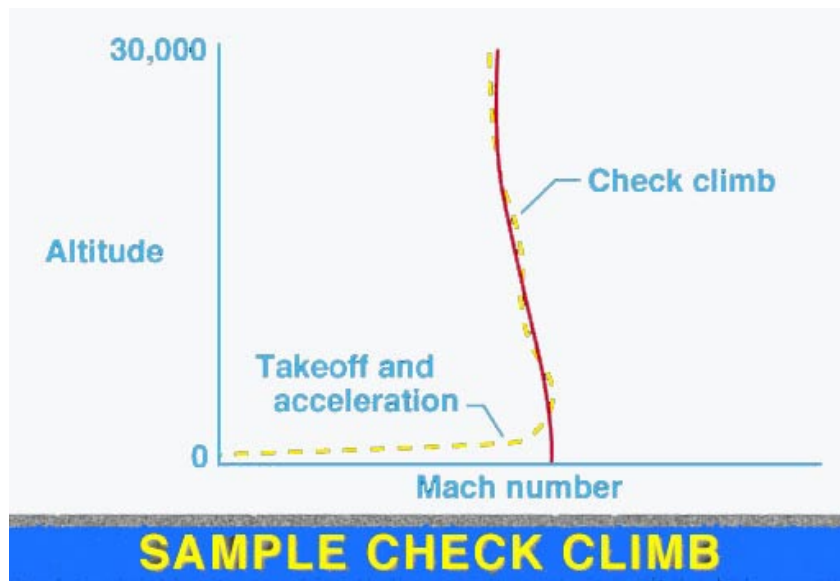
is quite demanding on the test pilot.) Once stabilized on the climb schedule the pilot will adjust speed as the airplane climbs so that the schedule of best-climb speed is maintained as the altitude increases. The check climb ends when the rate of climb drops below 100 feet per minute or when a pre-established maximum altitude has been reached.

## 6. Measures of Success

A successful check climb will meet the following test criteria:

1. All instrumented parameters recorded properly.
2. The weight at brake release was accurately known.
3. The transition maneuver was smooth and the best-climb schedule was established at the lowest practical altitude.
4. The pilot was able to maintain the best-climb schedule throughout the climb.
5. The resulting time-to-climb and fuel-used data were close to the values predicted, or, if not, the reason for the discrepancy is known.
6. Atmospheric parameters during the test were not bad enough to invalidate the test.

A sample check climb is compared with a best-climb schedule figure below.



# *Table 1-1*

## *Listing of Instrumentation Parameters*

<b>Parameter</b>	<b>Used For</b>
Airspeed	Compute Mach and dyn. pres.
Pressure Altitude	
Outside Air Temperature	
Engine RPM	Thrust corrections to standard-day conditions
Engine inlet pres. & temp	
Fuel flow	Compute fuel used
Radoisonde (weather balloon)	Wind and temp. corrections to standard day